

A NEW SPECIES OF QUERCUS (FAGACEAE) FROM SOUTHERN CALIFORNIA

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ABSTRACT

Quercus cornelius-mulleri Nixon & Steele is described from southern California, U.S.A., and Baja California Norte, Mexico. Fused-stellate trichomes, which were previously known in *Quercus* only in the series *Virentes*, are reported for the new species.

The scrub oaks of the subgenus *Quercus* (*Lepidobalanus* Endl. ex Oersted) in southern California have been a source of confusion to botanists since the earliest botanical expeditions (for a complete discussion of the nomenclatural history of the California scrub white oaks, see Tucker, 1952a). Trelease (1924) included all of the southern California scrub white oaks in *Quercus dumosa* Nutt., recognizing some varieties (such as var. *turbinella* (Greene) Trel.). Tucker (1952a, 1952b) established *Q. turbinella* Greene subsp. *californica* Tucker as a taxon distinct from *Q. dumosa*, with a range from the western edge of the Mojave Desert northward through the inner coast ranges to San Benito County. Tucker (1952a, 1953) did not include material from the desert border mountains of San Diego and Riverside Counties in his concept of *Q. turbinella* subsp. *californica*; this material, he felt, was "best referred to *Q. dumosa*, rather than *Q. turbinella*." Recent investigations indicate that these latter populations are representative of an undescribed species, distinct in fundamental morphological characters, distribution, and ecology from *Q. dumosa*, *Q. turbinella* subsp. *turbinella*, and *Q. turbinella* subsp. *californica*. It is a pleasure to name the species in honor of Professor Emeritus Cornelius H. Muller, both for his great contributions to oak taxonomy, and for his devotion to those fortunate enough to be his students.

Quercus cornelius-mulleri Nixon & Steele sp. nov.

Frutices sempervirentes multiramosi 1–2(–3) m alti; rami hornotini 1–1.5 mm diametro dense tomentulosi trichomatibus sessilibus stellatis breviradiatis; gemmae 2.5–3 mm longae ovoideae glabrae. Folia crassa coriacea ovata vel oblonga vel obovata vel subrotundata ad marginem dentata dentibus saepe minus quam 2 mm longis vel integra, supra obscure viridia, trichomatibus sparsis stellatis, subtus dense tomen-

tulosa trichomatibus sessilibus superpositis minutis radiis (8–)12(–16) ad basem coalescentibus usque ad 0.1 mm longis adpressis; petioli 2–5 mm longi tomentulosi. Amenta fructifera subsessilia; cupula fructifera hemisphaerica vel profunde cyathiformes; glans annua saepe fusiformis vel late conica sed variabilis.

Multi-stemmed rounded shrubs 1–2 or 3 m tall, the crowns densely branched; twigs of the season 1–1.5 mm in diameter, terete, densely short-stellate tomentulose (individual rays less than 0.2 mm long), persisting tomentulose the second year, occasionally only sparsely puberulent and brown; buds 2.5–3 mm long, ovoid, obtuse, glabrous and dull brown, the younger scales ciliate-hairy; stipules ca. 4 mm long, subulate, strigose, caducous; leaves evergreen, rather thick and coriaceous, ovate to oblong or narrowly obovate, or subrotund, apically acute or rounded, basally rounded to cuneate, the margins sparingly toothed throughout or entire, flat or sometimes undulate, cartilaginously thickened, the teeth sclerenchymatously tipped, the spines usually shorter than 2 mm; upper surface dull green, sparsely pubescent with minute stellate hairs, 0.15–0.17 mm in diameter, about 1 mm distant or much more sparse or occasionally deciduous; lower surface appearing glaucous because of a dense tomentulum of overlapping minute stellate hairs, to 0.2 mm in diameter, closely appressed, consisting usually of 12 (from 8 to 16) rays fused at their bases and forming a flattened rotate cluster; glandular trichomes absent on mature leaves; the midrib yellow against the white or ivory tomentulum; veins 6 or 7 on each side, slightly raised above, more prominent (even under tomentulum) beneath, irregularly branched and anastomosing; petioles 2–5 mm long, tomentulose similarly to the twigs or less so on the abaxial side; staminate catkins 25–55 mm long on slender sparsely pubescent rachises, the flowers distant except for the congested distal quarter, calyx lobes ciliate, the filaments markedly exerted, anthers glabrous; pistillate catkins subsessile with clusters of 2–3 flowers or sometimes solitary; fruit annual, solitary, paired, or in clusters of 3, subsessile; cups hemispheric to cup-shaped, or sometimes deeply cupped, basally rounded, as much as 20 mm broad and 13 mm high, scales somewhat thickened basally, gray-tomentulose throughout or the short thin apices glabrous and brown; acorns variable, usually fusiform or broadly conical to ellipsoid, 20–30 mm long and 10–13 mm broad or smaller, glabrous except at the puberulent apices, the basal one-third enclosed in the cups.

TYPE: USA, California, San Diego Co., ca. 24.7 km on McCain Valley Road n. from its junction with Interstate 8 (32°45'N, 116°20'W), 1335 m elevation, July 24, 1980, *Nixon and Steele 2765* (Holotype: UCSB; isotypes: DAV, NY, RSA, SD, TEX, UC).

PARATYPES: México, Baja California Norte: Cantu Grade, 9.7 km e. of La Rumorosa, *Moran 13147* (RSA, SD); 6 km e. of La Rumorosa,

then n. 0.8 km, *Steele 374C, 374E* (UCSB); 6.4 km s. of La Rumorosa, *Steele and Nixon 383* (UCSB); 32 km s. of La Rumorosa, *Nixon and Hendon 2335A* (UCSB); USA, CA, San Diego Co.: McCain's Ranch, Manzanita Indian Reservation, *Gander 8880* (SD); Montezuma Valley, *Muller 4040* (CHM); *Dubbers, Harbison and Higgins 44.129* (SD); 1.5 km e. of Burnt Rancheria Campground, Laguna Mountains, *Cox s.n.* (SD); 11.2 km e. on County Rd. S22 from its junction with County Rd. S2, Culp Valley, *Steele and Hendon 391* (UCSB); Riverside Co.: Hidden Valley Campground, Joshua Tree Natl. Monument, *Wilken 7552* (UCSB); 21 km s. of Palm Desert on CA Highway 74, *Nixon and Hendon 2547* (UCSB); San Bernardino Co.: Dry Morongo Creek, *Dunkle 3378* (LAM); 19 km s. on CA Highway 18 from its junction with CA Highway 247, *Nixon and Hendon 2553* (UCSB, TEX).

Quercus cornelius-mulleri occurs on the northeastern side of the San Bernardino Mountains, eastward to the granitic mountains of Joshua Tree National Monument, southward along the desert margin of the San Jacinto Mountains to the Laguna Mountains in San Diego County, and extends into Baja California Norte, Mexico, along the eastern escarpment of the Sierra Juarez. The southernmost known population is approximately 40 km south of the international border, but it is likely that the species is found further to the south, possibly along the east side of the Sierra San Pedro Martir.

The species usually occurs on granitic soils in association with *Pinus monophylla* Torr. & Frem., between elevations of 1000 m and 1800 m. Additional associates include *Juniperus californica* Carr., *Adenostoma sparsifolium* Torr., *Rhus ovata* Wats., and at the lower elevational limits, such desert species as *Larrea tridentata* (Sessé & Moc. ex DC.) Cov.

Morphological and distributional differences among the four taxa of scrub oak (subgenus *Lepidobalanus*) that are found south of the Transverse Ranges are outlined in Table 1.

The Baja California populations lie in the single-needle piñon belt (*Pinus monophylla*), at an elevation below those of *Q. turbinella* subsp. *turbinella*. *Quercus turbinella* is associated commonly with four-needle piñon (*P. quadrifolia* Parl. ex Sudw.) in this area. The two oak species are readily distinguished by differences in leaf spination, leaf color, peduncle length, and trichome characters (see Table 1). In their zone of contact, hybrids occur sporadically, but there is little indication of introgression away from the contact area into the main populations of either species.

Quercus cornelius-mulleri is not in contact with either *Q. turbinella* subsp. *turbinella* or *Q. turbinella* subsp. *californica* in San Diego and Riverside Counties. However, *Q. engelmannii* Greene, and to a lesser extent, *Q. dumosa*, enter its range in this area. Hybridization between

Q. cornelius-mulleri and *Q. engelmannii* has been confused often with hybridization between the latter and either *Q. turbinella* subsp. *californica* (not in the area) or *Q. dumosa*. The type of *Q. acutidens* Torr., collected by Parry (NY!) is such an intermediate and was probably collected along the trail inland from San Luis Rey. In this vicinity (near Warner Springs), "pure" populations of both species come to within 8 km of each other, with intervening populations showing indications of hybridization. Some hybridization between *Q. dumosa* and *Q. cornelius-mulleri* occurs where coastal elements mix with desert elements in the areas of relatively low mountain passes. This situation occurs sporadically, such as in the vicinity of Garner Valley and Santa Rosa Summit, Riverside County, and Montezuma Valley, San Diego County.

From Cajon Pass (San Bernardino County) westward, *Q. cornelius-mulleri* is replaced by *Q. turbinella* subsp. *californica* in the interior and *Q. dumosa* in the coastal areas. There does not appear to be contact between *Q. cornelius-mulleri* and the former, although this might be expected east of Cajon Pass on the north side of the San Bernardino Mountains. *Quercus cornelius-mulleri* is also the common scrub oak in the granitic ranges from Morongo Valley eastward into Joshua Tree National Monument. The desert scrub oak of the New York Mountains of eastern San Bernardino County is *Quercus turbinella* subsp. *turbinella*, which also occurs commonly to the east in the desert ranges of Arizona, New Mexico, west Texas, and northern Mexico (see Tucker, 1952a).

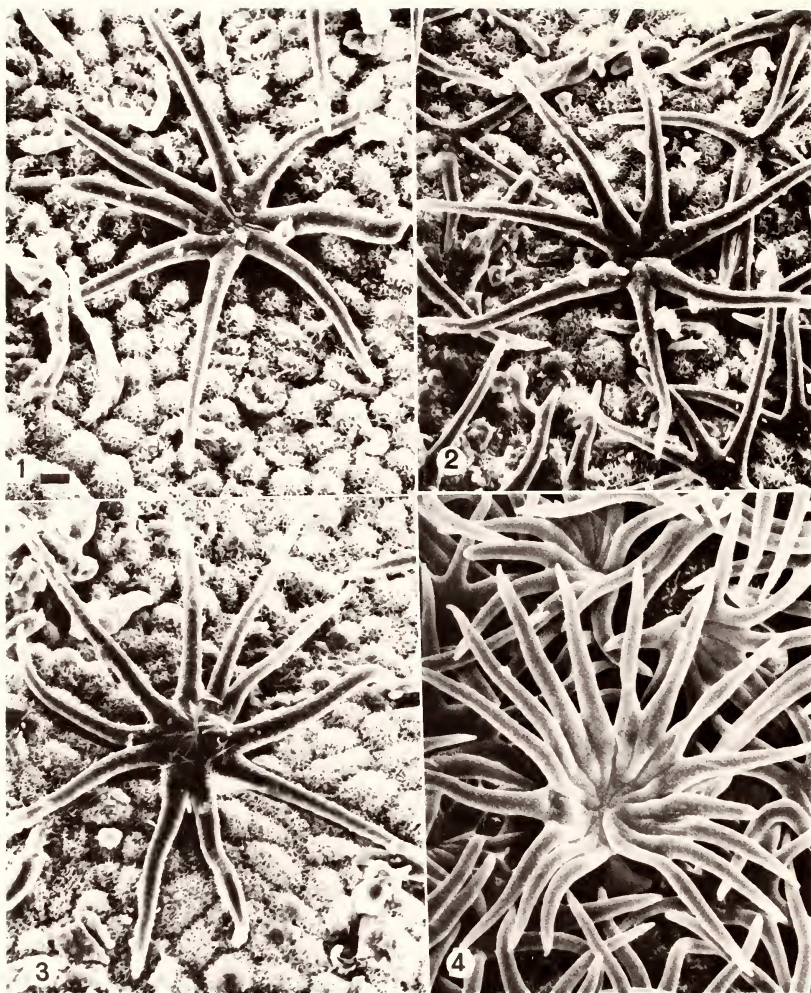
Characters of leaf trichomes have been used to distinguish species of *Quercus* in previous studies (Dyal, 1936; Tucker, 1952b; Tucker and Muller, 1957). More recently, Hardin (1976, 1979) has shown the value of scanning electron microscopy (SEM) in the study of *Quercus* leaf trichomes. Scanning electron microscopy indicates that *Q. cornelius-mulleri* is unique among the California oaks in its possession of fused-stellate trichomes on the lower leaf surface (see Figs. 1-4). Hardin (1976) defined the fused-stellate trichome as "a 'non-glandular' trichome with fusion of the rays beyond the base to a maximum of two-thirds the length of the rays." Although the foliar trichomes of *Q. cornelius-mulleri* are typically highly fused, the degree of fusion varies both on individual plants and within populations. No geographic patterns of trichome variability are apparent within the species. Hardin (1979) reported fused-stellate trichomes only for the series *Virentes* Trel., a small, closely related group of white oaks from the South-eastern United States, Mexico, and Central America. Since *Q. cornelius-mulleri* shares no other important diagnostic features with the *Virentes* (which possess connate cotyledons, pubescent anthers, and thick pubescent acorn cup-bases) there is no reason to assume any close relationship between *Q. cornelius-mulleri* and the latter group.

TABLE 1. MORPHOLOGICAL AND DISTRIBUTIONAL CHARACTERS OF THE SOUTHERN CALIFORNIA SCRUB WHITE OAKS.

Character	<i>Q. cornelius-mulleri</i>	<i>Q. dumosa</i>	<i>Q. turbinella</i> subsp. <i>turbinella</i>	<i>Q. turbinella</i> subsp. <i>californica</i>
Leaf base	oblique to rounded	oblique to rounded	cordate to rounded	variable, often slightly decurrent
Leaf color	bicolored, upper surface gray or yellow green, lower surface white to ivory	± unicolored, upper surface green, lower surface dull green	± unicolored, both surfaces yellow-green to gray-green	± unicolored, both surfaces gray-green
Leaf margins	sparingly toothed or entire to spinescent	mucronate-dentate to entire, rarely spinose	regularly spinescent-toothed	irregularly spinescent-toothed
Leaf pubescence—upper surface	sparsely to moderately stellate-pubescent	glabrous to sparsely stellate-pubescent	± uniformly stellate-pubescent	± uniformly stellate-pubescent
Leaf pubescence—lower surface	very dense, ± covering entire lower surface and obscuring the 2° veins	sparse, concentrated near the midrib and not obscuring the 2° veins	moderate, uniformly scattered over the surface but not obscuring the 2° veins	sparse to moderate not obscuring the 2° veins
Pubescence type	stellate and fused-stellate hairs only	stellate hairs and some uniseriate glandular hairs	stellate hairs and many uniseriate glandular hairs	stellate hairs and some uniseriate glandular hairs
Diameter of stellate hairs	0.16–0.26 mm	0.18–0.26 mm	0.21–0.36 mm	0.18–0.24 mm

TABLE 1. CONTINUED.

Character	<i>Q. cornelius-mulleri</i>	<i>Q. dumosa</i>	<i>Q. turbinella</i> subsp. <i>turbinella</i>	<i>Q. turbinella</i> Subsp. <i>californica</i>
Ray number	(8-12(-16)	(6-8(-10)	(8-10(-14)	(6-8(-12)
Ray fusion (visible with SEM)	yes	no	no	no
Acorn attachment	sessile or subsessile	sessile or subsessile	pedunculate	sessile or subsessile
Acorn cup scales	thin to tuberculate	tuberculate	thin	usually thin
Distribution	desert margins of San Bernardino Mts. of southern California south through the San Jacinto Mts. and the Laguna Mts. to the Sierra Juarez of Baja California Norte	coastal (mostly) slopes from northern Baja California to Tehama Co. and the north coast ranges of California	eastern California (New York Mts.) east to Arizona and Texas; Baja California Norte	inner coast ranges from Cajon Pass (San Bernardino Co., CA) north to San Benito Co., California
Elevation	1000 m-1800 m	30 m-1600 m	1400 m-2000 m	300 m-2000 m
Habitats	desert margin in the lower piñon belt and/or desert chapparral	chapparral, southern oak woodland	desert chapparral, upper piñon, (Baja California) piñon-juniper woodland (Arizona)	interior chapparral, piñon-juniper woodland, foothill woodland



FIGS. 1-4. Scanning electron micrographs of abaxial leaf surfaces of southern California scrub white oaks. FIG. 1. *Quercus dumosa* Nutt. (Ventura Co., Muller 5220 (Muller Private Herbarium)). FIG. 2. *Quercus turbinella* Greene subsp. *californica* Tucker (Santa Barbara Co., Tucker 1885-4 (Muller Private Herbarium)). FIG. 3. *Quercus turbinella* Greene subsp. *turbinella* (Baja California Norte, Steele and Nixon 386 (UCSB)). FIG. 4. *Quercus cornelius-mulleri* Nixon & Steele (Baja California Norte, Moran 13147 (SD)). Scale (FIG. 1) 10 μ m. All figures to the same scale.

Further study is needed before the relationships of *Q. cornelius-mulleri* can be determined.

In addition to ray-fusion in the stellate trichomes of *Q. cornelius-mulleri*, the high ray number, usually around twelve per trichome but



FIG. 5. Typical fruiting specimen of *Quercus cornelius-mulleri* Nixon & Steele. (San Diego Co., 3.2 km w. of Jucumba on old Highway 80 (UCSB). The bar is equal to 1 cm. Fruit and twig to same scale.

often up to sixteen, amply separates it from all other California white oaks. *Quercus dumosa* and *Q. turbinella* subsp. *californica* possess typically eight rays per foliar trichome. The mean ray number of foliar trichomes of *Q. turbinella* subsp. *turbinella* is approximately ten. The density of trichome cover in *Q. cornelius-mulleri* is also unique among the California scrub oaks. The lower leaf epidermis is typically occluded by the densely packed, appressed, minute trichomes. The stellate trichomes of the other three scrub oaks are never so dense as to obscure totally the lower leaf surface. Glandular trichomes (simple

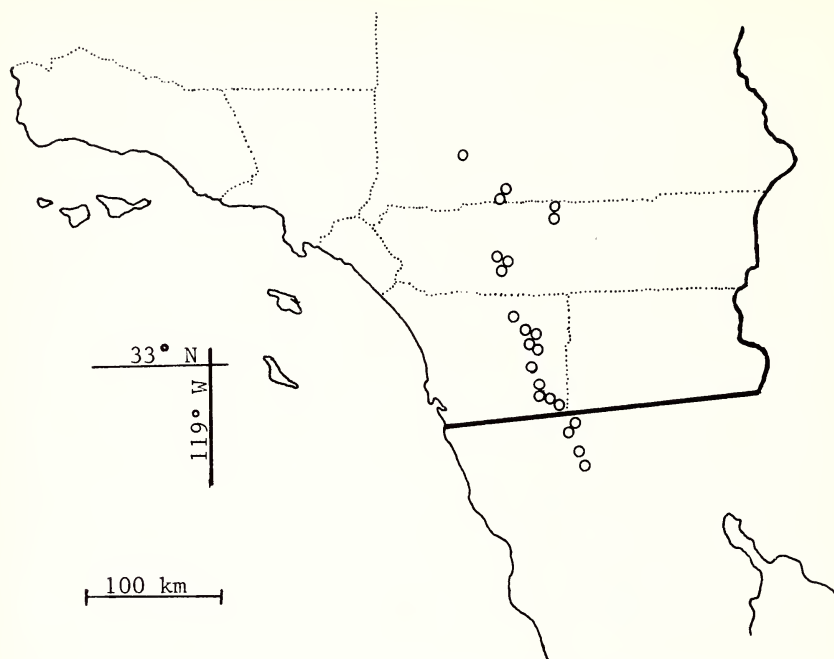


FIG. 6. Distribution of *Quercus cornelius-mulleri* Nixon & Steele in California and Baja California Norte, Mexico.

uniseriate trichomes, as defined by Hardin, 1976) are lacking on the mature leaves of *Q. cornelius-mulleri*, but are consistently found on the mature leaves of the other California white oaks.

These fundamental differences between *Q. cornelius-mulleri* and the other scrub white oaks of southern California preclude its inclusion as a subspecific taxon within any of those species. Similarly, there is no evidence that the populations which constitute *Q. cornelius-mulleri* were derived by hybridization from any of the extant California species. It is not intermediate morphologically or ecologically between any known species. On the contrary, it is unique among California oaks morphologically; and based upon its distribution, it appears to be more xeromorphically adapted than the other California scrub oaks.

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